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AUTHOR Caponigri, Rocco S.; And Others
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ABSTRACT

Efforts to institutionalize Bloom's Mastery Learning Concept at the City Colleges of Chicago (CCC) are described. Information on the City Colleges and the adaptation of mastery learning are presented, and the growth of the project in five phases beginning in 1972 is sketched. The optimal pattern for mastery learning consists of a series of small units of material, each presented to the student by traditional techniques but followed by a diagnostic quiz, specific correctives, and a parallel diagnostic quiz. This approach to the cognitive side of student learning provides frequent feedback to the student and promotes individualized instruction. Additional techniques are directed at improving students' attitudes about themselves as learners. The program began in 1972-73 with four faculty members, two in mathematics and two in biology. During the Spring 1980 semester the project involved 129 CCC faculty and 229 mastery classes. To encourage teachers to try mastery learning, the project conducts workshops on the practical use of mastery techniques in the classroom, and three credit hours toward salary advancement are granted. Mastery learning materials that workshop participants are required to develop and implement are outlined. Data on student academic performance, attrition, and other measures are compared for mastery classes and regular classes. The evaluation data are presented for each of the five phases of implementation. A recent study is seeking to determine which of the components of Bloom's Mastery Learning Model are most strongly correlated with teaching effectiveness. (SW)

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THE IMPACT OF MASTERY LEARNING ON PERFORMANCE AND ATTRITION

by

Rocco S. Caponigri
Margaret Matheis
Mark Schumann

Chicago City-Wide College
One of the City Colleges of Chicago
Chicago, Illinois

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SYNOPSIS

This paper is a description of our efforts to institutionalize Bloom's Mastery Learning Concept at the City Colleges of Chicago (CCC). Included are brief descriptions of the City Colleges, our adaptation of Mastery Learning, the details of CCC's Mastery Learning Project, the training we provide to Mastery Learning instructors, and an analysis of data. While institutionalization remains incomplete, the considerable effort put forth by the City Colleges of Chicago has already garnered promising results.

BACKGROUND OF THE COLLEGES

The City Colleges of Chicago (CCC) is a multi-college institution serving more than 110,000 full-time and part-time students. CCC faces the same problems confronted by all big city community colleges: declining enrollment, maintaining academic standards, poorly prepared students, high drop-out rates, sky-rocketing costs, and a decline in faculty morale.

CCC consists of seven traditional community colleges plus Chicago City-Wide College (CCWC) and the Chicago Urban Skills Institute (CUSI). CUSI serves 38,000 students, including voc-tech students, foreign-born people of all ages needing English language skills, and adults performing below the high school level in reading, writing, and mathematics. CCWC is a non-traditional college that develops and oversees special programs for students not easily served by the other campuses. The Mastery Learning Project for example, is based at CCWC, with programs at the other seven colleges.

The 'typical' student is a black woman in her mid-twenties who works, maintains a home, and attends school part-time. Approximately 57% of our students are black, 28% are white, 6% Hispanic, and the remainder are other minorities. Excluding CUSI and the Adult Education program, about 58% of our students are part-time, 54% are female, and 33% receive some form of financial aid. Excluding CUSI, the full-time (15 credit hour) equivalent enrollment is approximately 42,000.

Because of the many problems created by educating such a diverse student population, CCC contacted Dr. Bloom at the University of Chicago in order to learn more about Mastery Learning.

Research on Mastery Learning in community colleges, however, had mostly been conducted on a small scale and, though Mastery Learning had proved successful where tested, questions remained: Could Mastery Learning be implemented on a large scale? What would be the effect on achievement for a student whose schedule consisted solely of Mastery classes? What impact would such a curriculum have on academic standards, enrollment, attrition rates and faculty morale? Would it be cost effective? Could Mastery Learning be institutionalized? The CCC Project seeks to answer these questions as well as to identify other issues that are pertinent to Mastery Learning Theory and practice at the community college level.

A DEFINITION OF MASTERY LEARNING

Mastery Learning is a teaching/learning strategy designed to be implemented in the traditional classroom setting. Its goal is to have all students reach the high degree of learning previously attained only by the 'A' students. By dividing the course into units, by specifying the objectives of each unit, and by providing frequent feedback and alternative learning experiences, Mastery Learning helps all students learn the way the best students learn. Based on the premise that aptitude is proportional to learning rate, Mastery Learning attempts to maximize the quality of classroom instruction and minimize the time a student needs to learn. It does this through two distinct phases: planning, which includes setting standards and developing materials; and implementation, which includes monitoring student performance, providing frequent feedback to the student, and providing alternative learning experiences.

Mastery Learning is based on the conceptual model that John B. Carroll developed in A Model of School Learning (1963). He stated that the degree of school learning of a given subject depends on the student's perseverance combined with his opportunity to learn relative to his aptitude for the subject, the quality of his instruction, and his ability to understand instruction. Below is a mathematical formulation of the model.

Degree of School Learning = 1. Perseverance 2. Opportunity to Learn
3. Aptitude 4. Quality of Instruction
5. Ability to Understand Instruction

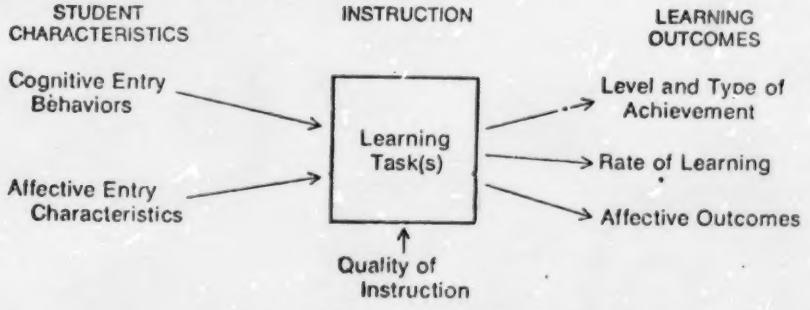
In the formula above, variables 1 and 2 (Perseverance and Opportunity to Learn), are summarized as the time spent in the learning process, and variables 3, 4 and 5 (Aptitude, Quality of Instruction and Ability to Understand Instruction) determine the time needed to learn. This simplifies the model, and its formula becomes:

$$\text{Degree of Learning} = F\left(\frac{\text{Time spent}}{\text{Time needed}}\right).$$

Therefore, as the time spent in learning approaches the time needed to learn, the student approaches subject mastery.

In 1968 Bloom adapted Carroll's model in Learning for Mastery. Bloom contends that individual differences in learning are observable phenomena which can be predicted, explained, and altered in a great variety of ways. In contrast, individual differences in learners are more difficult to explain and modify. Bloom determined that three interdependent variables account for much of the variation in school learning:

* The extent to which the student has already learned the prerequisites necessary to understand a subject.
* The extent to which the student is (or can be) motivated to engage in the learning process.
* The extent to which the instruction is appropriate to the learner.



MAJOR VARIABLES IN THE THEORY OF SCHOOL LEARNING

In the above figure, Cognitive Entry Behaviors is the prerequisite learning necessary to learning the task(s) at hand; Affective Entry Characteristics is the student's motivation to learn the new learning task(s); Quality of Instruction is the extent to which the cues, practice, and reinforcement of the learning are appropriate to the needs of the learner.

Since 1968, over 100 papers on Mastery Learning have been published in journals or have been presented at conferences, and over 25 dissertations have investigated Mastery Learning strategies. Mastery Learning strategies have been developed in virtually all academic and in many non-academic disciplines. The three main approaches to Mastery Learning are stated by Bloom, Keller and Postlewaithe, who have all based their work to some extent on Carroll's model and on success in the classroom. Bloom's Mastery Learning strategy emphasizes those variables of Carroll's model that are accessible to educators. Because Bloom's strategy requires only minimal changes in the traditional classroom routine, it tends to be less resisted by faculty than other innovative techniques.

In the City Colleges of Chicago we are committed to open enrollment; thus, many CCC students are not only poorly prepared for college-level work but also have poor attitudes toward learning. Additionally, we are restricted by a finite semester and limited resources. Our students often come to us without the prerequisites for the courses they enroll in, even courses that are traditionally offered at the beginning of a college curriculum. In response to these conditions, we have selected Bloom's approach to meet our needs. In the City Colleges of Chicago we have presented Mastery Learning as a workable means of individualizing instruction within the traditional classroom setting.

The optimal pattern for our Mastery Learning consists of a series of small units of material, each presented to the student by traditional techniques but followed by a diagnostic quiz, specific correctives, and a parallel diagnostic quiz. This procedure, the crux of our approach to the cognitive side of student learning, provides frequent feedback to the student and allows us to individualize instruction. Additional techniques are aimed at bolstering students' attitudes about themselves as learners. Rather elaborate preparations are necessary before the teacher begins to teach a class using Mastery Learning techniques. The pre-conditions of Mastery are discussed in the section entitled, "The Training of Mastery Learning Teachers."

HISTORY OF THE CCC
MASTERY LEARNING PROJECT

For our purposes we will divide the growth of the Mastery Learning Project into five phases. Although Mastery Learning strategies had been developed and utilized by individual instructors throughout the CCC system since 1969, it wasn't until 1972 and the infusion of Federal funds under Title III of the 1964 Higher Educational Act that a unified effort began. The program began in 1972-1973 with four faculty members, two in mathematics and two in biology. In 1973-1974 nine faculty members were added, and in 1974-1975 seven more. By 1975 the following disciplines were represented: architecture, electronics, nursing, speech, black studies, English, humanities, accounting, social science, economics, foreign language and chemistry.

PHASE I: 1972-1975

All of these initial efforts were held at Olive-Harvey College, one of the City Colleges of Chicago. Because of the positive results of this early work, the central administration decided to attempt to institutionalize the Mastery Learning concept by expanding the program to the other colleges. This marked the beginning of Phase II.

PHASE II: 1976-1977

In the spring of 1976 about 80 CCC instructors were brought together in a special seminar in Mastery Learning at the University of Chicago. There, Professor Benjamin S. Bloom explained the theory and application of Mastery Learning. Instructors were divided into groups according to their subject area: biology, counseling, English composition, history, mathematics, nursing, psychology, reading, and Spanish. Instructors then worked in groups to develop formative test items, correctives and summative test items for use in their subject areas. During the 1976-1977 academic year the Mastery Learning Project involved 2,211 students in 77 classes taught by 37 instructors. During this phase efforts were focused on answering two key questions: Are Mastery Learning strategies more successful in improving student performance and in reducing attrition than non-mastery techniques? Is Mastery Learning equally successful in all subject areas?

Faculty who participated in this phase of the project were asked to teach at least one section using Mastery Learning plus another section employing the technique they traditionally used. When the mastery classes were compared to the traditional classes — despite large variations among individual instructors and classes — the comparison showed that Mastery Learning techniques were superior to non-mastery techniques, both in increasing achievement and in reducing attrtion (see the "Analysis of the Data" section).

PHASE III: 1977-1978

Encouraged by the success of the first two phases of the Mastery Learning Project, the CCC central administration decided to offer another workshop during the summer of 1977 under the auspices of the Center for Instructional and Staff Development of Chicago City-Wide College. This marked the beginning of Phase III, which was characterized by an increasing administrative commitment toward efforts to institutionalize Mastery Learning. Thirty-five faculty members participated in this workshop. Teachers were still asked to teach a mastery and a control class. To help faculty cope with the clerical work of their mastery classes and to help them monitor student progress, the teachers were provided with Mastery Learning Managers (MLM). In this third phase of CCC's Mastery Learning Project, Mastery Learning was introduced to 27 additional classes and 892 more students in these disciplines: accounting, shorthand, business machines, typing, electronics, child development, English grammar, humanities, physical science, music, science, geography, sociology, psychology, history, Spanish, and nursing.

PHASE IV: 1978-1979

The first three phases of the Mastery Learning Project focused on introducing Mastery Learning to CCC faculty. Phase IV was characterized by a large administrative commitment and an established structure for the day-to-day management of the project. On each campus a faculty member acted as coordinator for the Mastery Learning activities in that campus, such as training MLM's and assigning them to mastery teachers. On-going activities carried out at a central level included data collection and analysis, research, training new mastery teachers, and

publishing a newsletter. The Mastery Learning Project's job was to promote the adoption and utilization of Mastery Learning techniques, encourage the exploration of modification to our present methods, and establish and maintain a Mastery Learning Library.

In the first three phases of the Mastery Learning Project, spanning the years from 1972 to 1978, mastery classes, regardless of the subject, were more successful than control classes in improving student performance and lowering attrition rates. Phase IV, which began in the Fall of 1977 with 120 teachers teaching 187 courses, sought to answer a broader question: Can Mastery Learning be institutionalized? That is, will a sufficient number of teachers use Mastery Learning so that students can begin to select courses using this technique? Can the long prevailing attitudes of some administrators and teachers be changed? Will teachers be willing to put forth the extra effort for a long period of time?

PHASE V: 1979-1980

Because the differences in performance and attrition between mastery classes and traditional classes were not as great as suggested by Mastery Learning theory and many of the microstudies, in Phase V we began to examine more closely the components of Mastery Learning that contribute most heavily to effective teaching. To do this we experimented with the development of the Mastery Learning Teaching Methods Questionnaire (MLTMQ) and a measure of teaching effectiveness. The data from these two instruments is being collected and analyzed and will be reported later. However, we have compiled tables similar to those compiled for Phases I through IV and these are shown in the data analysis section.

THE TRAINING OF MASTERY LEARNING TEACHERS

To encourage teachers to try Mastery Learning, the Mastery Learning Project conducts workshops on the practical use of mastery techniques in the classroom. In addition, the CCC administration grants three credit hours towards lane (salary) advancement. Workshop participants are required to develop a set of Mastery Learning materials and implement their Mastery Learning strategy in the classroom in at least one course for one semester. The materials developed are:

ABSOLUTE STANDARDS

All Mastery Learning strategies require that absolute (rather than curved) grading standards be established at the outset of the course. To establish valid absolute standards, teachers must examine their previous examinations and objectives and revise their standards if necessary.

ORIENTATION NOTES

Orientation notes, given to students on day one, introduce students to Mastery Learning and to the course. The notes emphasize that every student can earn an 'A;' they describe available alternative learning experiences; they include all requirements and procedures for making up missed tests; they describe the grading scale and how grades will be assigned; they list rules of conduct, alternate learning resources, and describe the purpose and effectiveness of peer tutoring.

TOPICAL OUTLINE WITH HOMEWORK ASSIGNMENTS

A topical outline, complete with homework assignments (also given to students on day one) briefly states the topics to be covered and the homework assignments for each class period of the term (there are 16, 32, or 48 class periods in the term, depending on whether the class meets 1, 2 or 3 times a week). Because students often regard reading as a 'non-assignment,' homework assignments should require the students to do something in addition to reading.

LESSON OBJECTIVES

Lesson objectives, for each class period, using Mager's format, state in writing the behaviors that students will be asked to exhibit in order to demonstrate mastery of each lesson's content, the conditions or constraints under which the student will be tested, and the criteria of acceptable performance. Three to five objectives are written for each lesson.

TABLES OF SPECIFICATIONS AND UNITS

Tables of Specifications. used by mastery teachers during the planning stage. divide the class lessons into units, classifying the material of each unit according to Bloom's taxonomy and showing the interrelation among the various items. The tables further help to outline the course and to aid in the development of evaluation instruments. Ideally, a unit is approximately two weeks long provided that the material can be broken down "naturally" into units of this length. Teachers are asked to identify and arrange the content of each unit so that the cognitive prerequisites for later units are covered in earlier units. Since the Tables of Specifications serve as guides to the structure of both the course and its tests, topics can be rearranged, added, or deleted so that students will more easily reach the course goals.

FORMATIVE QUIZZES

Formative quizzes are designed to inform teachers and students alike about student mastery of essential concepts and skills. Through these quizzes, students always know what they have mastered or need to study further. Quizzes are usually multiple choice, but other types can be used if required by the subject matter. Quizzes are given at the end of each unit, and they cover the content shown in that unit's Table of Specifications. Since the primary job of formatives is to inform, they need not count towards the student's grade, but they are scored and returned to the student as soon as possible.

MASTERY LEARNING MANAGERS

A recent adaptation has been the introduction of Mastery Learning Managers. CCC uses CETA (Comprehensive Employment & Training Act) personnel as paraprofessionals to assist Mastery Learning teachers. The best of these CETA personnel have been instrumental in improving students' attitudes toward school and learning. The MLM guides and supports students' learning activities, especially because students often perceive the MLM as more accessible and less threatening than the instructor. A Mastery Learning Manager:

1. Arranges a weekly work schedule with the teacher (This schedule should overlap the teacher's on-campus schedule).
2. Attends every class the teacher holds so as to provide the teacher with feedback on the class' progress, to support the teacher's strategy, and to provide information to the students.
3. Tutors students as needed.
4. Organizes, schedules and monitors small group sessions.
5. Monitors the corrective phase of the Mastery Learning technique.
6. Contacts, by telephone or mail, all students absent from class.
7. Administers formatives and retakes to students absent from class.
8. Keeps daily non-official attendance records.
9. Keeps records of formative and summative evaluations.
10. Meets the typing and other clerical needs of the teacher.
11. Develops quiz items and correctives, provided the teacher feels this is appropriate.
12. Performs other related duties as assigned by the teacher.

Since the Mastery Learning Manager relieves the teacher of a great deal of clerical work, the teacher is free to spend more time with individual students. The Mastery Learning Manager also contributes directly to the individualization of instruction by advising students on which alternative learning experiences to use.

SMALL GROUP SESSIONS

Each student is assigned to a group of 3 to 5 students. The prime purpose of this peer tutoring group is to permit students to help each other with correctives. Every student in class must meet with his group for 20-30 minutes either before or after class. The MLM monitors these groups and acts as a resource person. Research at the University of Chicago and our own experience have shown such peer tutoring to be very effective. By contacting absentee students in a positive way, the manager helps them keep up with the class. Many instructors observe that these activities improve students' attitudes about their ability to learn. In turn, this improved attitude has a positive effect on their actual ability to learn.

To assist teachers who were not able to attend the workshops, Dr. Caponigri, with the help of Mastery Learning faculty and staff, assembled The Mastery Learning Workbook (1979). This workbook was designed to guide faculty through the materials- development stage. In addition to practical information about the develoment of mastery materials, it contains a brief overview of the theoretical aspects of each component of mastery. The workbook consists of 10 units.

ANALYSIS OF THE DATA

The following Phase I data is taken from ERIC Topical paper number 53, Mastery Learning: A Strategy for Academic Success in a Community College, written by City Colleges of Chicago Professors Jones, Gordon and Schectman, December 1975.

PHASE I: 1972-1975

DO STUDENTS IN MASTERY CLASSES RECEIVE HIGHER GRADES THAN STUDENTS IN NON-MASTERY CLASSES TAUGHT BY THE SAME INSTRUCTOR?

During Phase I of the Mastery Learning Project, "Mastery" and "Control" Classes were taught by the same instructor, had the same objectives, used the same materials, and in many cases were given the same final examination. The major difference was that the students in the Mastery Classes were exposed to the Formative - Corrective - Retake process. Overall, students in mastery classes performed better and received higher grades than did students in control classes. In all but one case, (See Table I) the students in mastery classes showed significantly better academic achievement than students in control classes. Mastery classes had more 'A's' and 'B's' and fewer 'D's' and 'F's,' with a mean final grade of 2.96 in the mastery classes (A = 4.00) as opposed to a mean final grade of 2.40 in the control classes. The attrition rate in mastery classes was 36.9% and in control classes 37.5%, a minimal difference. It may be significant to note that in Mathematics 112 and Chemistry 121, the teachers had only one semester's experience with mastery techniques. And in one of these classes, Chemistry 121, students in the control class received a higher percentage of 'A's' and 'B's' than students in the mastery class. The data in Table I also suggests that some mastery instructors may need some experience (perhaps 2 or 3 semesters worth) in order to realize the greater effectiveness of the mastery technique.

TABLE I

Phase I: 1972 - 1975. Percentages of Final Grades Awarded to Students in Mastery and Control Classes

	MASTERY						CONTROL					
	Students	% A's	% B's	% C's	% D's	% F's	Students	% A's	% B's	% C's	% D's	% F's
BIOLOGY 111[1]	33	36	33	30	0	0	20	10	25	60	5	0
BUSINESS 101[2]	26	35	42	15	4	4	18	28	17	28	17	10
CHEMISTRY 121[3]	31	23	23	42	10	3	20	15	50	15	15	5
ECONOMICS 202[1]	19	47	16	16	21	0	24	4	25	50	8	13
ENGLISH 101[2]	40	60	20	13	5	2	18	17	33	22	28	0
HUMANITIES[2]	42	63	30	7	0	0	27	15	67	18	0	0
MATHEMATICS 112[3]	24	37	33	13	13	4	37	8	41	35	14	2
SOCIAL SCIENCE 102[2]	52	13	35	21	19	12	24	4	21	33	17	25
SPANISH 101[2]	29	59	31	7	3	0	19	42	26	32	0	0
TOTAL	296	41	30	18	8	3	207	14	35	33	11	6

[1]Taught by instructors who have had three or more semesters' experience with Mastery Learning

[2]Taught by instructors who have had two semesters' experience with Mastery Learning

[3]Taught by instructors who have had one semester's experience with Mastery Learning

FOR OUR PURPOSES, WE SAY THAT STUDENTS HAVE ACHIEVED MASTERY IN A COURSE IF THEY RECEIVE AN A OR A B. WHAT PERCENTAGE OF STUDENTS IN PHASE I MASTERY CLASSES WILL ACHIEVE MASTERY? HOW DOES THIS COMPARE WITH THE PERCENTAGE OF STUDENTS ACHIEVING MASTERY IN CONTROL CLASSES?

In theory, 90% of the students exposed to Mastery Techniques will achieve mastery, indicated by receiving an A or B. Table II indicates this theoretical goal is achieved in two cases, in Spanish and humanities. However, 22 percent more students achieve A or B grades in the mastery classes than in the control classes. The percentage of A's and B's in the mastery and control classes are positively correlated (rho = 0.63). Two possible explanations for this are: (1) teacher grading practices tend to remain the same regardless of the learning strategy; and/or (2) the techniques used in the mastery class carry over to the non-mastery class.

TABLE II

Phase I: 1972 - 1975. Percentage of A and B Grades Awarded to Students in Mastery and Control Classes

	MASTERY		CONTROL	
	Students	% A's + B's	Students	% A's + B's
BIOLOGY 111[1]	33	69	20	35
BUSINESS 101[2]	26	77	18	45
CHEMISTRY 121[3]	31	46	20	65
ECONOMICS 202[1]	19	63	24	29
ENGLISH 101[2]	40	80	18	50
HUMANITIES[2]	42	95	27	82
MATHEMATICS 112[3]	24	70	37	49
SOCIAL SCIENCE 102[2]	52	48	24	25
SPANISH 101[2]	29	90	19	68
TOTAL	296	71	207	49

[1]Taught by instructors who have had three or more semesters' experience with Mastery Learning

[2]Taught by instructors who have had two semesters' experience with Mastery Learning

[3]Taught by instructors who have had one semester's experience with Mastery Learning

TO WHAT DEGREE MUST STUDENTS COMMIT THEMSELVES TO THE MASTERY PROCESS TO ACHIEVE THE FULL POTENTIAL OF THE TECHNIQUE?

During Phase I, data were gathered to investigate the interaction between student performance and student involvement in the essential activities prescribed under the mastery approach. Each instructor established minimum requirements for student participation: a maximum number of absences, a maximum number of missed formatives, and the like. At the end of the semester they classified students in their mastery group as "Met Minimum Requirements" or "Did Not Meet Minimum Requirements." More than 80% of the mastery students who met minimum requirements achieved final grades of 'A' or 'B,' whereas, only 28% of those who did not meet these standards received final grades of 'A' or 'B.' The results in Table III make it clear that to benefit from Mastery Learning, students must fully participate in the process. While it would be of interest to investigate the effect of participation on the achievement level of students in control classes in order to compare the results with those of mastery classes, such an investigation and comparison could not be made because the concept of minimum participation requirements is not typically a part of a control class and could not be introduced without changing the nature of those classes. Still, the data summarized in Table III below clearly shows that mastery students who fully participate in the mastery strategy achieve at higher levels than those mastery students who do not. Mastery Learning managers were incorporated during Phase III to encourage students to fully participate in mastery activities.

TABLE III

Phase I; 1972 - 1975. Grade Distribution in Mastery Classes for Students Who Met, and Did Non Meet Minimum Requirements for Mastery

	MASTERY STUDENTS WHO MET MINIMUM REQUIREMENTS						MASTERY STUDENTS WHO DID NOT MEET MINIMUM REQUIREMENTS					
	Students	% A's	% B's	% C's	% D's	% F's	Students	% A's	% B's	% C's	% D's	% F's
BIOLOGY 111	19	47	33	0	0	0	14	7	14	63	14	0
BUSINESS 101	16	37	62	0	0	0	10	30	10	40	10	10
ENGLISH 101	36	64	19	14	3	0	4	25	25	0	25	25
SOCIAL SCIENCES 102	32	19	44	16	12	9	20	5	20	30	30	15
SPANISH 101	27	63	33	4	0	0	2	0	0	100	0	0
TOTAL	130	47	38	8	4	2	50	12	16	42	20	10

PHASE II: 1976 - 1977

IS THE SAME HIGH LEVEL OF PERFORMANCE ACHIEVED BY THE STUDENTS IN THE MASTERY CLASSES WHEN THE PROGRAM IS EXPANDED TO ALL OF THE CITY COLLEGES?

In Phase II the Mastery Learning Project involved 2,211 students in 77 classes taught by 37 instructors. This phase sought to answer the same questions as Phase I regarding performance and attrition but in a broader context. In Phase I Mastery Learning was confined to Olive-Harvey College; in Phase II the program was expanded to all of the City Colleges of Chicago. Not surprisingly, a few problems developed. At Olive-Harvey most of the instructors followed a single Mastery Learning format, but as the program expanded it became impossible to maintain the same consistency. In Phase II many instructors varied the implementation of their Mastery Learning strategy to match their teaching styles. Although the results were not as dramatic, they followed the same pattern as in Phase I: performance improved and attrition decreased. In Phase II, as in Phase I, teachers were asked to teach a Mastery class and a control class. However, in many cases it turned out to be impossible to hold the mastery and control classes during the same semester or in the same time pattern. This fact made it difficult to compare the mastery and the control classes; yet, Table IV indicates that 43% of the students in mastery classes received an 'A' or 'B' while only 35% of the students in control classes received an 'A' or 'B.' Also it should be noted that 28% of the mastery group received a 'D' or 'F' while 35% of the

control group did.

TABLE IV

Phase II: 1976 - 1977. Percentages of Final Grades Awarded to Students in Mastery and Control Classes

	MASTERY CLASSES						CONTROL CLASSES					
	Students	% A's	% B's	% C's	% D's	% F's	Students	% A's	% B's	% C's	% D's	% F's
BIOLOGY 101	137	6	15	45	15	18	117	7	15	37	21	21
COUNSELING 101	37	22	28	28	17	6	30	13	17	40	13	17
ENGLISH 101	154	7	34	29	16	15	96	11	24	38	13	14
HISTORY 111	48	21	25	15	21	18	39	15	8	23	31	23
MATHEMATICS 103	245	18	17	23	15	27	175	14	14	14	18	39
NURSING 101	42	17	67	14	2	0	28	7	50	36	4	4
PSYCHOLOGY 201	93	16	27	39	4	14	82	6	30	42	17	15
READING 125/6	114	42	28	23	7	0	112	27	32	29	1	11
SPANISH 101	32	44	19	22	16	0	25	48	36	8	8	0
TOTAL	902	18	25	28	13	15	704	14	21	30	14	21

ON COMMON EXAMINATIONS DO STUDENTS IN MASTERY CLASSES RECEIVE HIGHER SCORES THAN STUDENTS IN NON-MASTERY CLASSES?

A review of the data from Phase I often raises a question regarding the equivalence of grades. That is, is an "A" in a mastery class equal to an "A" in the corresponding control class? In an attempt to resolve this question, data was collected that allowed the comparison of mastery and control students on a common final examination. Table V contains these results and shows that the mastery students scored higher than the control students in seven out of the nine comparisons. Further, in all five cases where the differences were significant at the .05 level, students in the mastery classes achieved a higher level than did students in the control classes.

The data from Phase II was collected by researchers Guskey and Monsaas and reported in Research in Higher Education, (Vol. 11 No. 3, 1979) in an article entitled "Mastery Learning: A Model for Academic Success in Urban Junior Colleges."

TABLE V

Phase II: 1976 - 1977. Average Percent of Correct Answer on a Common Final Examination

	MASTERY		CONTROL	
	Students	% Correct	Students	% Correct
BIOLOGY 101	130	52.1	110	49.4
COUNSELING 101*	36	75.6	25	69.8
ENGLISH 101	141	68.5	84	69.4
HISTORY 111*	21	60.0	17	47.6
MATHEMATICS 103*	191	62.7	128	58.3
NURSING 101	42	85.2	28	85.0
PSYCHOLOGY 201*	82	64.8	77	56.8
READING 125/6*	90	81.9	88	73.0
SPANISH 101	31	70.9	28	75.7

*The mean difference between percent correct in Mastery and Control classes is significant at $p < .05$.

DOES THE IMPROVEMENT OF STUDENT PERFORMANCE IN MASTERY CLASSES HAVE A DELETERIOUS EFFECT ON RETENTION?

The improvement of student performance increases rather than decreases student retention in mastery classes. Attrition rates were 27% in mastery classes and 32% in control classes. When mastery classes were compared to control classes, the attrition rate was lower in mastery classes in 2/3 of the comparisons. Specifically, lower rates of attrition were found in mastery classes in Biology 101, Counseling 101, History 111, Mathematics 103, Psychology 201; higher rates of attrition were found in mastery classes in English 101, Reading 125-126 and Spanish 101. Probably, the higher attrition rate in the Spanish class can be discounted due to the small class size in both the mastery and control classes. However, the higher rate of attrition in the mastery classes of English and reading raises the questions of universal applicability of the mastery technique. This question is answered in the subsequent phases of this study. Table VI contains these results.

TABLE VI

Phase II: 1976 - 1977. Attrition in Mastery and Control Classes

	MASTERY			CONTROL		
	Students	Withdrawals	%	Students	Withdrawals	%
BIOLOGY 101	185	48	26	186	69	37
COUNSELING 101	50	11	22	49	16	33
ENGLISH 101	207	72	35	136	38	28
HISTORY 111	62	13	21	56	17	30
MATHEMATICS 103	356	98	28	277	88	32
NURSING 101*	48	6	13			
PSYCHOLOGY 201	136	43	32	151	71	47
READING 125/6	149	30	20	140	25	18
SPANISH 101	11	1	9	12	0	0
TOTAL	1204	322	27	1007	324	32

*Because the Nursing 101 Control class was taught during the previous academic year, comparable attrition data were not available.

PHASE III: 1977 - 1978

CAN NEW MASTERY TEACHERS USE THE TECHNIQUE SUCCESSFULLY?

Because the goal of the project during Phase III was to introduce new teachers to the mastery technique, data was collected only on new instructors. And, since mastery Learning had only been introduced in 1976-1977, it was not possible to obtain data for instructors with more experience. Thus, it was not possible to test the conjecture that mastery instructors become more efficient as they gain experience with the technique. In this phase of the project, 892 students were enrolled in 20 new Mastery Learning courses and 644 students were enrolled in 18 control courses. The schedule did not permit the teachers of Geography 101 and Sociology 201 to teach a control class. The attrition rate for all mastery classes was 22%, while it was 26% for all control classes. (Excluding Geography 101 and Sociology 201, the attrition rate is 23% in mastery classes and 26% in control classes.). Even though the data includes only teachers with little or no prior experience with the mastery technique, attrition was again lower in mastery classes than in control classes. This data is summarized in Table VII.

TABLE VII

Phase III: 1977 - 1978. Attrition
in Mastery and Control Classes

	MASTERY			CONTROL		
	Students	Withdrawals	%	Students	Withdrawals	%
ACCOUNTING[1]	80	14	18	51	16	31
CHILD DEVELOPMENT 101	27	8	30	29	5	17
ELECTRONICS 132[1]	27	6	22	37	10	27
ENGLISH 103[1]	89	22	25	25	12	48
GEOGRAPHY 101[2]	29	1	3			
HISTORY 111[1]	58	16	28	34	16	47
HUMANITIES 201[1]	81	9	11	70	21	30
MACHINE COMP.[1]	32	12	38	27	12	44
MATHEMATICS 103/112	30	7	23	54	10	19
MATHEMATICS 111[1]	31	4	13	27	9	33
MUSIC 101[1]	37	10	27	38	12	32
NURSING 101	48	1	2	51	0	0
PHYSICAL SCIENCE 101	32	2	6	35	1	3
PSYCHOLOGY 201	70	21	30	57	16	26
SCIENCE 101[2]	37	9	24			
SHORTHAND[1]	58	27	47	21	12	57
SOCIAL SCIENCE 101	27	8	30	32	7	22
SOCIOLOGY 201[2]	31	3	10			
SPANISH 101	37	8	22	28	5	16
TYPING	31	7	23	28	3	11
TOTAL	892	195	22	644	167	26

[1]Subjects in which the attrition rate is substantially lower.

[2]Control data is not available for this class.

HOW LONG DOES IT TAKE NEW MASTERY TEACHERS TO BEGIN TO SHOW AN IMPROVEMENT IN STUDENT PERFORMANCE?

Table VIII reveals little difference in academic performance between mastery and control classes. In the mastery classes 46% of the students received A's and B's whereas 45% received those grades in the control classes. Both mastery and control classes have 28% D's and F's. Again, it is important to note that all of the teachers in this phase of the study are using mastery techniques for the first time. In comparing this data to Phase I data, it appears that teachers need experience with mastery techniques to produce significantly better results than those achieved in control classes.

TABLE VIII

Phase III: 1977 - 1978. Percentage of Final Grades Awarded to Students in Mastery and Control Classes

	MASTERY						CONTROL					
	Students	% A's	% B's	% C's	% D's	% F's	Students	% A's	% B's	% C's	% D's	% F's
ACCOUNTING	66	26	33	24	11	6	35	23	49	17	5	6
CHILD DEVELOPMENT 101	19	32	37	9	11	11	24	17	21	24	21	17
ELECTRONICS 132	21	19	19	14	10	38	27	11	22	15	15	37
ENGLISH 103	67	12	15	12	18	43	13	38	15	32	0	15
GEOGRAPHY 101*	28	18	43	14	7	18						
HISTORY 111	42	7	33	38	17	5	18	17	0	33	44	6
HUMANITIES 201	72	22	38	33	4	3	49	22	37	19	16	6
MACHINE COMP.	20	10	50	15	25	0	15	0	27	60	6	7
MATHEMATICS 103/112	23	35	4	35	26	0	44	34	34	0	32	0
MATHEMATICS 111	27	7	15	15	19	44	18	6	11	0	11	72
MUSIC 101	27	30	7	29	4	30	26	27	31	15	0	27
NURSING 101	47	2	32	38	17	11	51	4	33	29	14	20
PHYSICAL SCIENCE 101	30	23	23	41	13	0	34	9	26	56	9	0
PSYCHOLOGY 201	49	12	33	41	8	6	41	10	27	51	5	7
SCIENCE 101*	28	18	54	10	7	11						
SHORTHAND	31	35	19	21	6	19	9	33	11	56	0	0
SOCIAL SCIENCE 101	19	21	16	5	5	53	25	12	28	32	4	24
SOCIOLOGY 201*	28	11	18	43	29	0						
SPANISH 101	29	14	10	19	14	43	23	22	22	22	4	30
TYPING	24	38	25	33	4	0	25	0	36	28	36	0
TOTAL	697	19	27	26	12	16	477	16	29	27	14	14

*Control data is not available for this class.

The data for Phase III was taken from a report prepared by Frank Guida, entitled "Final Evaluation of the Mastery Learning Project for the City Colleges of Chicago: 1977 - 1978 School Year."

PHASE IV: 1978 - 1979

Unlike the previous phases, where only the original participants at Olive-Harvey College plus those new mastery teachers who also participated in a CCC workshop were identified as mastery teachers, during Phase IV we included all CCC faculty who developed and used mastery techniques in their classes (as defined in "A Definition of Mastery Learning," above).

Phase IV also varied from the previous phases in that teachers were not asked to teach control classes. Instead, classes taught by non-mastery teachers were used for comparisons. Though this makes a direct comparison of mastery-control pairs impossible, it does allow a meaningful comparison of the mastery technique with other techniques.

WHAT IS THE EFFECT ON ATTRITION WHEN MASTERY STRATEGIES ARE IMPLEMENTED ON A LARGE SCALE?

In the Fall Semester 1978, 120 teachers elected to teach 187 mastery classes. In the Spring Semester 1979, 161 teachers elected to teach 216 mastery classes. Data were analyzed to answer the following questions: Do students in mastery classes perform better than students in non-mastery classes taught by other instructors? Is attrition lower in mastery classes? Table IX shows attrition data for the Fall 1978, and Spring 1979 semesters. The 'W' and 'Z' grades are given for administrative reasons: 'W' indicates a student-initiated withdrawal and 'Z' indicates that a student is no longer in attendance. The overall attrition rate (W+Z) and the unsuccessful completion rate (F+W+Z) was lower in mastery classes than in non-mastery classes. This is consistent with similar results found in the previous years of the study.

TABLE IX

Phase IV: 1978 - 1979. Attrition in Mastery and Non-mastery Classes.

	MASTERY				NON-MASTERY			
	Classes	Students	% W's & Z's	% F's, W's & Z's	Classes	Students	% W's & Z's	% F's, W's & Z's
DALEY	22	684	28	36	43	1308	33	44
KENNEDY-KING	79	2341	28	53	358	10,327	30	54
LOOP	60	1785	15	37	244	6873	18	36
MALCOLM X	73	1885	14	38	341	8954	15	49
OLIVE-HARVEY	87	2407	24	36	289	7513	23	41
TRUMAN	41	1325	25	37	183	5250	33	46
WRIGHT	41	1095	16	31	87	2487	23	39
TOTAL	403	11,522	21	40	1545	42,712	24	46

In the mastery classes the attrition ranges from a high of 28% at Daley and Kennedy-King Colleges, to a low of 14% at Malcolm X College. In the non-mastery classes, the highest attrition

(33%) is found at Daley and Truman Colleges and the lowest attrition is found at Malcolm X. At all colleges a fairly high percentage of F grades were awarded.

WHAT IS THE EFFECT ON STUDENT PERFORMANCE WHEN MASTERY STRATEGIES ARE IMPLEMENTED ON A LARGE SCALE ?

Table X summarizes the academic grades for the Fall Semester 1978: 40.2% of the mastery students received 'A's' or 'B's;' 33.8% of the non-mastery students achieved that standard. The failure rate is lower in mastery classes than in non-mastery classes: 25% vs. 29.5%. This data indicates that mastery students receive significantly higher grades than do students in non-mastery classes.

TABLE X

Phase IV: 1978 - 1979. Percentage of Final Grades Awarded to Students in Mastery and Non-mastery Classes

	MASTERY							NON-MASTERY						
	Classes	Students	% A's	% B's	% C's	% D's	% F's	Classes	Students	% A's	% B's	% C's	% D's	% F's
DALEY	22	453	25	25	25	13	13	43	782	21	24	28	9	18
KENNEDY-KING	79	1645	11	16	23	14	35	358	7038	10	16	25	15	34
LOOP	60	1451	20	20	23	8	28	244	5433	15	22	28	13	23
MALCOLM X	73	1450	17	22	21	9	31	341	7121	14	19	19	6	42
OLIVE-HARVEY	87	1627	22	23	26	11	20	289	5323	17	22	26	11	24
TRUMAN	41	870	17	23	30	14	15	183	3401	13	21	28	18	21
WRIGHT	41	871	27	25	22	7	18	87	1861	18	22	27	12	22
TOTAL	403	8367	19	21	24	11	25	1545	30,959	14	20	25	12	30

PHASE V: 1979 - 1980

Up to this point the differences in performance and attrition have not been as large as predicted by Mastery Learning theory and by microstudies, including those conducted at Olive-Harvey College. Research reported in "Modification and Discontinuence of Mastery Learning Strategies" (Froh and Muraki, 1980) demonstrated that many Mastery Learning faculty have modified components of Bloom's Mastery Learning model. In Phase V we began to examine more closely the components of the model to determine which contribute most to effective teaching and learning in the City Colleges of Chicago. We developed a questionnaire, the Mastery

Learning Teaching Methods Scale, and a Measure of Teaching Effectiveness in order to carry out this study. The data from these is being analyzed and will be reported later. Performance and attrition data for Phase V are reported below; it generally follows the pattern of the previous phases, with mastery classes showing improved student performance and decreased attrition.

During the Fall 1979 semester, 120 CCC faculty taught 195 mastery classes. During the Spring 1980 semester, 129 CCC faculty taught 229 mastery classes. In this academic year, 11,602 student enrolled in 424 mastery classes. Data from 1,602 non-mastery classes were averaged to make comparisons with the mastery classes. The non-mastery classes were matched to the mastery classes by college, department, and course.

The Table XI summarizes attrition data for Phase V. Overall, 37% of the students in mastery classes received 'F,' 'W,' or 'Z' grades, where as 40% of the students in non-mastery classes recieved these grades. Attrition was lower in mastery classes at six of the seven colleges.

TABLE XI

Phase V: Attrition Rates in
Mastery and Non-mastery Classes

	MASTERY				NON-MASTERY			
	Classes	Students	% of W's & Z's	% of F's, W's & Z's	Classes	Students	% of W's & Z's	% of F's, W's & Z's
DALEY COLLEGE	14	440	22	28	66	2,022	27	37
KENNEDY-KING COLLEGE	77	2,039	26	47	406	11,155	25	50
LOOP COLLEGE	55	1,618	20	36	222	6,476	17	33
MALCOLM X COLLEGE	92	2,393	14	38	308	8,037	17	43
OLIVE-HARVEY COLLEGE	91	2,379	23	32	227	5,910	23	36
TRUMAN COLLEGE	61	1,786	26	39	231	6,013	29	41
WRIGHT COLLEGE	34	947	16	25	142	4,314	19	31
TOTAL	424	11,602	21	37	1,602	43,927	22	40

This is comparable to earlier results. Table XII summarizes performance data for Phase V. Overall, 7% more students earned 'A's' and 'B's' in mastery classes than in non-mastery classes;

4% fewer students earned 'D's' and 'F's' in mastery classes than in non-mastery classes. This is comparable to earlier results and reveals less of an improvement over traditional techniques than expected.

TABLE XII

Phase V: Academic Grades in
Mastery and Non-mastery Classes

	MASTERY							NON-MASTERY						
	Classes	Students	% A's	% B's	% C's	% D's	% F's	Classes	Students	% A's	% B's	% C's	% D's	% F's
Daley	14	315	39	24	23	6	8	66	1,349	20	27	30	8	14
Kennedy-King	77	1,447	9	14	26	19	31	406	8,068	11	15	26	17	30
Loop	55	1,256	22	20	25	11	22	222	5,194	15	22	30	14	19
Malcolm X	92	1,837	19	22	22	6	31	308	5,965	17	22	19	6	35
Olive-Harvey	91	1,555	26	24	28	8	14	227	4,080	17	24	29	12	18
Truman	61	1,243	19	28	24	12	17	231	4,022	17	21	29	14	18
Wright	34	729	36	25	21	7	11	142	3,378	17	25	32	11	16
TOTAL	424	8,382	21	22	24	10	22	1,602	32,056	15	21	27	12	24

Because of the differences in the effectiveness among Mastery Learning Teachers, in Phase V we began a study to determine which of the components of Bloom's Mastery Learning Model are most strongly correlated with teaching effectiveness. To accomplish this we developed the Mastery Learning Teaching Methods Questionnaire (MLTMQ) and the Index of Teaching Efficiency (ITE).

The MLTMQ is a questionnaire administered to Mastery teachers which is designed to determine the value each teacher places on each component and the degree to which that component is actually implemented in the classroom. The distinct components of Bloom's model used in this questionnaire are: topical outline, learning units, tables of specifications, behavioral objectives, orientation, assignments, formative evaluations, correctives, retake formative evaluations, small groups, certificates of mastery, summative evaluation(s), and standards for grading.

The research is designed to correlate each of these components with the criterion measure of teaching efficiency. Teacher efficiency is measured by the Index of Teaching Efficiency (ITE). This Index is analogous to Grade Point Average. That is, ITE is to a teacher what GPA is to a student. However, ITE is an improvement over GPA in that it is a thrice corrected measure. It is corrected for the differences due to: (1) The section of the class (time at which the class is held); (2) the course level; and (3) the academic department. The section correction allows for the comparison of the same course at different times; i.e., English 101 A vs. English 101 F. The section-course correction allows for the comparison of English 101 A with English 102 B. The section-course-department correction allows for the comparison of English 101 A with Math 201 B.

The uncorrected measure is calculated by the use of the following formula:

$$E = \frac{5\,A+4\,B+3\,C+2\,D+1\,F}{5\,(A+B+C+D+F+W)},$$

where A, B, C, D, and F are the numbers of students receiving those grades, and W is the number of students who withdraw from the class. Therefore the optimum value for this uncorrected measure is 1.00 and it is achieved when all students who register for the class are retained and every student receives a grade of 'A.'

The section-correction is calculated in a similar way.

$$Se = \frac{5\,A+4\,B+3\,C+2\,D+1\,F}{5\,(A+B+C+D+F+W)},$$

where A, B, C, D, and F are the numbers of students who received those grades in a particular section (time). By dividing the uncorrected E by Se we correct the measure for the variation in the sections of a particular course. $E_s = \frac{E}{Se}$ if E_s is greater than 1.00 the class is doing better than the average class in that section, and conversely. The corrections due to variation in course-level and academic department are calculated in similar fashion.

If the MLTMQ and ITE are valid, the correlations between the Mastery Learning Teaching Methods Questionnaire and the ITE will show which components of Bloom's Mastery Learning Model contribute most to the effectiveness of mastery teachers in the City Colleges of Chicago. This research will be reported as it is completed.

Because of the success and interest generated by the Mastery Learning Project at the City Colleges of Chicago, HEW and the Office of Education funded a program, the Special Services Mastery Project (SSMP). This project focuses on the coordinated delivery of support services to selected, full-time disadvantaged and handicapped students at Loop and Truman Colleges. The project is administered at Chicago City-Wide College by the Project Director. At each campus, a Project Coordinator selects student participants, coordinates project activities on campus, and trains and supervises staff activities. Project staff are responsible for the identification and selection of handicapped project participants, the training of project and campus staff with regard to the specific needs and problems of the handicapped, and for the scheduling of specialized support services such as tutors, interpreters, readers, notetakers, and attendants for handicapped participants. Four hundred students enrolled in Mastery Learning classes are identified, their progress intensively monitored, and extra services in the form of tutoring and specialized activities are delivered. The goal of the project is to increase the performance and retention rates of students whose educational and financial deficiencies render them inequitably competitive with the average community college student, through a program of support services offered in conjunction with Mastery Learning classes.

Demographically, the ethnic/racial composition of these students in the Spring 1980 semester was 57% Black, 18% White, 14% Hispanic, 7% Asian/Pacific Islander, and 3% American Indian/Alaskan Native. Sexual composition was 65% female and 35% male.

Table XIII reports the percentage of students earning 'A,' 'B,' or 'C' grades (performance), and the percentage of students earning 'A,' 'B,' 'C,' 'D,' or 'F' grades (retention) for students served by the SSMP, for students in non-mastery classes comparable to mastery classes in which the SSMP students were enrolled, and for all students at Loop and Truman Colleges.

TABLE XIII
SPECIAL SERVICES
MASTERY PROJECT

	N	PERFORMANCE	RETENTION
SSMP Students		68%	88%
Comparison classes		48%	73%
All classes		55%	74%

Both performance and retention rates for project participants are higher than those for control classes and for all classes in the two colleges. In addition to being enrolled in Mastery classes,

SSMP students received the support services offered by the project. This includes a total of 1,125 tutoring contacts during the semester.

The SSMP offers several activities for participants on an on-going basis. Each semester, students participate in an orientation to the program at a session where they meet the staff, share ideas regarding career options and course scheduling, and receive information concerning future events for that term. The SSMP sponsors the Career Planning Program issued by ACT with feedback continuously offered throughout the year. A Needs Assessment is completed for every student. Together, the student and staff ascertain academic areas of concern and work at alleviating problems. Tutoring is the nucleus of the program. The Mastery Learning Manager functions as a liaison between faculty and students as well as a peer tutor.

Besides on-going activities, the SSMP has offered Study Skills Workshops, a three-part mini-series for the handicapped, a personal goal-setting weekly group for the Handicapped, Open House "mingling" sessions, special topical seminars such as conversational English for students in the English as a Second Language program, films with discussion, and many referrals with follow-up. It is assumed that "active concern" in the form of varied and constant support services has been the most important ingredient in achieving these results.

SUMMARY

The following set of tables is an attempt to put into perspective all five phases of CCC's Mastery Learning Project and to draw conclusions based on this data.

Table XIV shows the percentage of students who have successfully completed their courses. Students are considered to have successfully completed the course if they receive an 'A,' 'B,' 'C,' or 'D.' The data shows a trend toward grade deflation. That is, it appears that on a percentage basis, fewer passing grades were awarded in the more recent years. This may be due to (1) a change in grading policy over these years, and/or (2) the reaction of teachers to grade inflation and a return to previous standards, and/or (3) the fact that incoming students are less well prepared. It seems that the most valid interpretation of the data is that mastery classes have a more successful completion rate than non-mastery classes. With the exception of Phase III, it is unmistakable that the mastery classes prepare a higher percentage of students (about 6% more)

to take subsequent courses. As teachers become more familiar with mastery techniques, we estimate that this percentage difference will reach 15%. Based on the results of Phase I, which reported data from teachers experienced with mastery learning, we feel this to be a reasonable goal.

TABLE XIV

Phases I - V. Percentages of Students Successfully Completing Mastery and Non-mastery Classes

	MASTERY		NON-MASTERY	
	Number of Students Earning A thru F	% of Students Earning A thru D	Number of Students Earning A thru F	% of Students Earning A thru D
PHASE I: 1972 - 1975	296	97	207	93
PHASE II: 1976 - 1977	902	85	704	79
PHASE III: 1977 - 1978	697	84	477	86
PHASE IV: 1978 - 1979	8,367	75	30,959	70
PHASE V: 1979 - 1980	8,383	78	32,056	76
TOTAL	18,645	78	64,403	73

During Phases I, II and III, the same instructors taught both the mastery and the control classes. Phase IV includes control classes taught by both mastery teachers and non-mastery teachers. Therefore, the data from Phases I, II, and III can be used to compare mastery techniques with the traditional techniques those instructors used in former classes; whereas Phase IV data can be used to compare Mastery Learning strategies with traditional techniques employed by a variety of instructors.

While it is impossible to predict how an individual student will perform, Mastery Learning theory predicts that 90% of all learners can achieve the level of performance usually reached by the top 10% under traditional classroom approaches. As can be seen from the data summarized in Table XV, we do not achieve that standard. Only 42% of the students received 'A's' and 'B's' in Mastery classes. While this is 8% more 'A's' and 'B's' than received by students in non-mastery classes, it does not approach the 90% suggested by mastery theory. However, upon closer

scrutiny, it is revealed that when students fully partake in the mastery process, i.e., take all of the formative tests and do the correctives, the probability of receiving an A or B increases to about 85% (see Table III).

As we noted earlier, no data was collected to examine the relation between participation and performance in non-mastery classes, so we can make no judgments about the effects of participation in non-mastery classes. However, it is probably true that, regardless of technique, the more students participate, the better their performance. Data collected during Phase I shows that students who participate in the mastery processes (objectives, formatives, correctives, retakes, and summative(s)) are almost guaranteed success in these classes. In traditional classes, participation is often poorly defined; the student is expected to know how to study, how to find the salient points of a lecture, and so on. Sophisticated learners do, of course, understand these things but, too often, unsophisticated learners do not. Even now when other traditional methods of instruction are made available, students do not know how to utilize them and thus cannot fully benefit from them. Using Mastery Learning's highly structured approach with its specific correctives, teachers can insure that students who fully participate will succeed.

Many educational researchers question the reliability of grades in comparing educational outcomes. Accordingly, we tried comparing common final exams as well. However, since using exams as the basis of comparison produced the same results (see Tables IV and V) as did comparing grades, we decided that it was easier to compare grades only, especially since faculty were reluctant to administer common final exams as well as to submit all of the data required. Therefore, the 8% more 'A's' and 'B's' given to students in mastery classes (See Table XV) probably represents a true difference in achievement. We anticipate that as mastery teachers become familiar with the mastery process, the achievement differential will rise to the 15 - 20% level shown in Phase I, especially because the data reported from Phase I came from teachers with experience in using mastery techniques. In short, we conjecture that some experience is needed to achieve the potential improvement offered by the mastery technique. Furthermore, we feel that a 15 - 20% improvement in student achievement is a reasonable goal. Such an increase would have a ripple effect, with increasing numbers of well-prepared students passing to higher level courses. This would mean that a higher percentage of students would have the

cognitive prerequisites needed for more advanced courses, which would mean that a higher percentage of students in these courses would achieve mastery.

TABLE XV

Phases I - V. Percentage of Students Achieving Mastery in Mastery and Non-mastery Classes

	MASTERY		NON-MASTERY	
	Number of Students Earning A thru F	% of Students Earning A & B	Number of Students Earning A thru F	% of Students Earning A & B
PHASE I: 1972 - 1975	296	70	207	50
PHASE II: 1976 - 1977	902	43	704	35
PHASE III: 1977 - 1978	697	46	477	45
PHASE IV: 1978 - 1979	8,367	40	30,959	34
PHASE V: 1979 - 1980	8,383	43	32,056	36
TOTAL	18,645	42	64,403	35

The data in Table XVI contains the percentages of those students who did not successfully complete their mastery or non-mastery classes. The basis of the percentages is the total number of students who appear on the final class list. Contrasted to this total is the number of students who failed or withdrew. ("W" and "Z" are grades of withdrawal, the "W" being student-initiated, the "Z" being given by the teacher when a student stops coming to class. Because all students who receive an "F," "W," or "Z" grade are ineligible to take the next course in the sequence, it seemed proper to combine these grades in calculating the withdrawal rate.) It is worth noting in these figures that the pattern throughout the history of the Mastery Learning Project has been one of higher grades and lower attrition rates in mastery classes. Since there was a notable decline in the attrition rates from Phase I to Phase IV, it would seem that the most valid way to compare mastery and non-mastery classes is to compare only those classes taught during the same semester.

One interpretation of the data in Tables XV and XVI is that the comparison of mastery classes with control classes, as in Phases I, II, and III, produces results similar to those found in

Phase IV, when mastery classes are compared to the non-mastery classes. Specifically, the attrition rates for Phases I, II, and III are 36% for the mastery classes, and 41% for the control classes, a difference of 5%, which corresponds to the 5% difference in attrition rates between mastery classes and non-mastery classes in Phase IV. It would appear that there is no loss in generalizability by using non-mastery classes instead of control classes as the basis for determining the effectiveness of mastery techniques in reducing attrition.

Similar results can be seen in student performance. In Phases I, II, and III, 48% of the mastery students received 'A's' and 'B's' compared to 41% of the students in control classes. This difference of 7% closely corresponds to the 6% difference in achievement found in the Phase IV comparison of mastery and non-mastery classes (see Table XVI). This data, coupled with the fact that in Phase IV mastery classes are compared to classes taught by teachers outside the mastery project, justifies discontinuing the requirement that mastery teachers teach a control class as was required in Phases I, II, and III.

TABLE XVI

Phases I - IV. Percentage of Students
Not Successfully Completing
Mastery and Non-mastery Classes

	MASTERY		NON-MASTERY	
	Enrollment: A thru Z*	% of Students Receiving F, W & Z	Enrollment: A thru Z*	% of Students Receiving F, W & Z
PHASE I: 1972 - 1975	469	39	331	41
PHASE II: 1976 - 1977	1204	36	1007	45
PHASE III: 1977 - 1978	892	34	644	36
PHASE IV: 1978 - 1979	11,477	40	42,712	45
PHASE V: 1979 - 1980	11,602	37	43,927	40
TOTAL	25,644	38	88,621	42

*The R grade (incomplete) has been omitted.

IT IS CLEAR THAT A LOT OF WORK GOES INTO THE CONSTRUCTION OF A MASTERY COURSE. IS ANY EFFORT BEING MADE TO COLLECT THESE MATERIALS SO THAT A TEACHER WHO DECIDES TO USE MASTERY DOESN'T HAVE TO START FROM SCRATCH?

Information on courses for which teachers developed and implemented mastery materials is being collected and stored in CCC's Faculty Resource Library located on the 17th floor of the Chicago City-Wide College at 185 North Wabash Avenue. Now, when teachers decide to try Mastery Learning, they will be able to refer to these materials. By building on the experience of their predecessors, new mastery teachers will begin their mastery teaching with an improved more complete set of mastery materials.

DO MASTERY CLASSES RETAIN MORE STUDENTS THAN THE "TYPICAL" NON-MASTERY CLASS? DO STUDENTS IN THESE CLASSES PERFORM BETTER?

If one hypothesizes that mastery techniques and non-mastery techniques are equally effective in improving performance and if grades accurately reflect this performance, then the GPA of mastery classes should be higher than the GPA of non-mastery classes with the same frequency that the GPA of non-mastery classes is higher than the GPA of mastery classes. However, the data in Table XVII indicates that by this criteria mastery classes performed better than non-mastery classes in 68% of the comparisons, whereas non-mastery classes performed better than mastery classes in 32% of the comparisons.

Similar results are found when the attrition of mastery classes is compared with the attrition of non-mastery classes. 63% of the time mastery classes have lower attrition rates then non-mastery classes, whereas non-mastery classes have lower attrition rates then mastery classes in 37% of the comparisons.

When both of these variables - attrition and performance - are considered simultaneously, mastery classes have better performance and lower attrition in 44% of the comparisons, whereas non-mastery classes have better performance and lower attrition in 16% of the comparisons.

TABLE XVII

Paired Contrasts Between Mastery and
Non-mastery Classes: Summary by Phase

	Number of Contrast Pairs	% of Pairs in which Attrition was Lower in Mastery Classes	% of Pairs in which Performance was Higher in Mastery Classes	% of Pairs in which Mastery was Superior on Both Measures	% of Pairs in which Non-mastery was Superior on Both Measures
PHASE I: 1972 - 1975	9	89	89	89	11
PHASE II: 1976 - 1977	9	56	78	44	11
PHASE III: 1977 - 1978	18	56	50	28	22
PHASE IV: 1978 - 1979	131	63	68	43	12
TOTAL	167	63	68	44	13

WERE THERE ANY DIFFERENCES FOUND IN PHASE IV IN PERFORMANCE AND ATTRITION AMONG THE COLLEGES?

Table XVIII indicates that our best results were obtained at Wright College with all (100%) mastery classes retaining more students than comparable non-mastery classes. Moreover, in 80% of the classes, students received higher grades. Further research will attempt to determine the factors contributing to these results. However, based on all 131 contrasts, it appears that an improvement in attrition or performance can be expected in approximately two-thirds of the contrasts. Perhaps more importantly, an improvement in both attrition and performance is found 43% of the time.

TABLE XVIII

Paired Contrasts Between Mastery and Non-mastery Classes During Phase IV: Summary by College

	Number of Contrast Pairs	% of Pairs in which Attrition was Lower in Mastery Classes	% of Pairs in which Performance was Higher in Mastery Classes	% of Pairs in which Mastery was Superior on Both Measures	% of Pairs in which Non-mastery was Superior in Both Measures
DALEY COLLEGE	8	38	75	38	25
KENNEDY-KING COLLEGE	20	65	50	45	30
LOOP COLLEGE	23	52	70	35	13
MALCOLM X COLLEGE	27	63	70	37	4
OLIVE-HARVEY COLLEGE	27	70	67	44	7
TRUMAN COLLEGE	16	56	75	44	13
WRIGHT COLLEGE	10	100	80	80	0
TOTAL	131	63	68	43	12

WERE THERE ANY DIFFERENCES IN THE EFFECTIVENESS OF MASTERY LEARNING STRATEGIES AMONG THE VARIOUS SUBJECT AREAS DURING PHASE IV?

Table XIX indicates that the best results in both attrition and performance were found in mathematics. The poorest results were found in business, occupational and technical programs, and in humanities, art, music, and languages. Future research will investigate the factors that contribute to these differences.

TABLE XIX

Paired Contrasts Between Mastery and Non-mastery Classes: Summary by Subject Area

	Number of Contrast Pairs	% of Pairs in which Attrition was Lower in Mastery Classes	% of Pairs in which Performance was Higher in Mastery Classes	% of Pairs in which Mastery was Superior on Both Measures
BUSINESS, OCCUPATIONAL, AND TECHNICAL	32	53	66	34
ENGLISH, READING, AND SPEECH	20	65	70	45
HUMANITIES, ART, MUSIC, AND LANGUAGE	18	61	61	39
MATHEMATICS	18	78	78	61
NATURAL SCIENCES	45	69	64	44
SOCIAL SCIENCES, HISTORY, PSYCHOLOGY, AND CHILD DEVELOPMENT	34	62	74	50
TOTAL	167	64	68	45

DOES EXPOSURE TO MASTERY LEARNING HAVE ANY EFFECTS ON STUDENTS BEYOND REDUCING ATTRITION AND IMPROVING PERFORMANCE?

In a report, "An Interview Study" (Froh and Muraki, 1979), the authors researched the affective responses of CCC teachers who used mastery techniques. These teachers reported that they felt more positive toward, and less constrained in mastery courses than in traditional courses. The researchers reported that 65% of the teachers interviewed agreed that Mastery Learning helped students learn how to learn and that Mastery Learning helped students develop

confidence in their ability to learn. Both these conclusions are consistent with impressions we have obtained in informal talks with mastery teachers. Instructors reported that their mastery students felt better about themselves at the end of the course than they did at the beginning. Again, this result is consistant with the opinions of mastery teachers, as expressed in informal conversations and in attitude surveys that some instructors have conducted in their mastery classes.

Froh and Muraki also reported that many instructors have modified the mastery model. The reasons why mastery teachers modify the standard model will become the focus of further research. In this report we have concentrated on results that can be researched by simply examining the objective record, the grade reports.

FUTURE RESEARCH AND ACTIVITIES

Mastery Learning has been implemented in the City College in degrees of success varying from phenomenal to virtually nil. At this point we judge the project to be a modest success. Obviously, the bulk of our future research will be concerned with the effects on student achievement in a curriculum composed solely (or at least largely) of mastery classes. Also, we are interested in determining whether Mastery Learning helps students "learn how to learn". Research in these last two areas has already begun. With funding provided by an HEW Special Services for Disadvantaged Students Grant, we will conduct a one year study of 350 students enrolled in a curriculum composed of more than one mastery class. Other activities we will undertake in the near future are:

1. Provide more in-service training opportunities to increase the number of teachers using Mastery Learning.
2. Develop valid and reliable measures that identify the most successful teachers.
3. Study in-depth the techniques used by teachers previously identified as most successful.
4. Communicate to the faculty the techniques that work with CCC students.
5. Develop and maintain a faculty resource of Mastery Learning materials to be used as a reference when a faculty member attempts to develop a mastery course.
6. Improve the quality of the paraprofessional support to teachers by conducting in-service training for Mastery Learning managers.

7. Encourage and provide assistance to faculty in the use of media in the corrective phase of Mastery Learning.

8. Study the effects of exposure to mastery classes on students' self-concept and attitude toward school.

9. Study the effects on performances of participation in both mastery and traditional classes.

CONCLUDING COMMENTS

While the results of the Mastery Learning Project thus far are not overwhelmingly favorable, the trend is unmistakable: Mastery Learning can be successful at the community college level in a variety of subject areas. Data collected in CCC's Mastery Learning Project support the following conclusions:

1. Students must fully participate in the mastery process in order to obtain maximum benefit from it. Participation in the formative-corrective-retake cycles is especially vital. We base this conclusion on a comparison of the performance of students who met minimum requirements with those who did not (see Table III). From this data and from our own experience we believe that if a particular student participates in the process, the chances are 85% that he or she will receive an 'A' or 'B' and be better prepared to take a subsequent course.

2. Once individual teachers become more familiar with mastery techniques, their results will improve. This conclusion is based on a comparison of the results obtained by experienced teachers (Phase I) with teachers new to the mastery technique (Phase II). This should become even more apparent in subsequent semesters, when the decline in the ratio of new mastery teachers to experienced mastery teachers produces a corresponding improvement in results.

3. Mastery techniques have been shown to be effective in most subject areas. As shown in Table XIX mastery techniques reduced attrition in 64% of the comparisons and improved students' performance in 68% of the comparisons. As teachers perfect and personalize their approach to Mastery Learning, these figures are expected to approach 80 to 90%.

4. We feel that continuing to encourage teachers to develop their own mastery techniques, rather than requiring a strict adherence to a prescribed form, will speed the adoption of mastery learning the City College of Chicago.

5. Students in mastery classes often undergo a positive change in attitude toward themselves as learners and toward the subject. This conclusion is based primarily on the results of the report "An Interview Study" (Froh and Muraki, 1979), which is based on discussions with mastery teachers.

SIGNIFICANCE

Mastery Learning has never been viewed as a panacea. However, if the technique could be institutionalized with even a small degree of the effectiveness that is reported in the literature, it would help to lower attrition rates and raise student achievement. In turn, we expect that an improvement in student performance will improve faculty morale, not only because more students in a given class will be successful, but because more students will reach high level courses with the necessary prerequisites. In addition, lower attrition rates will improve job security. We can also expect that lower attrition rates and improved academic performance will ultimately translate into a cost-effective program. All of these benefits can be expected only if mastery does improve students' performance (grades) and decrease attrition, and only if enough faculty can be attracted to the program to make an impact on the whole institution. Fortunately, those variables are quantifiable and continue to serve as a measure of the program's success.

As previously stated, many questions remain regarding the institutionalization of Mastery Learning, yet the fact remains that teachers using the mastery approach can virtually guarantee success to students who fully participate in the program. Thus, successful implementation and institutionalization of Mastery Learning depends on the full participation of teachers and students.